ABSTRACT AND REFERENCES

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INVESTIGATION OF THE KINETIC LAWS AFFECTING THE ORGANIC SUSPENSION GRANULATION IN THE FLUIDIZED BED (p. 4–10)

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The authors prove that it is possible to reduce economic and environmental parameters in the processes of granulation and produce fertilizers by recycling, and further reprocessing of chicken manure. This prevents unprocessed manure from getting into the environment, and due to the organic origin of the material, the soil is not contaminated.

In order to reduce the cost of processing wet substances and increase homogeneity of the final product granulometric composition, it is proposed to fulfill granulation of organic suspensions in the fluidized bed devices. The mechanism of granule formation in a fluidized bed was studied and granulation temperature modes of organic suspensions were experimentally established. The process operating parameters have been determined, namely, maintaining temperature in the fluidized bed at 70 °C, one can continuously produce organic granules of high density and strength.

Heat transfer kinetics of organic suspension dehydration was studied, as well as convective heat transfer in the suspended layer was determined. Based on the obtained experimental data, the coefficient of heat transfer from the heat agent (air) to the surface of solid particles during evaporation of the suspension was calculated. The obtained criteria dependence makes it possible to predict a value of the heat transfer coefficient for the granulation process of chicken manure suspension.

The technological scheme of the production line for granular organic fertilizers for the cultivation of ecologically pure food products, which also takes into account the specific properties of unprocessed chicken manure, is proposed.

Keywords: granulation, fluidized bed devices, organic suspension, chicken manure, temperature mode.

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ANALYSIS OF MATRIX AND GRAPH MODELS OF TRANSMISSIONS FOR OPTIMIZATION THEIR DESIGN (p. 11–17)

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The application of heuristic methods in the design of transmissions is investigated. The entire path that the designer passes from the development of the design requirements, then the preliminary design and finally the development of the detailed design is considered. Heuristic methods are divided into three groups according to three design phases. For each phase, one generalized heuristic method that includes all heuristic techniques of the known methods referred to a particular group should be used when designing transmissions. Special attention is paid to the methods that use matrix and graph models. These methods are the most suitable for analyzing complex technical objects. Search for design features that are not used in right-angle gearboxes is performed by the method of creativity enhancement. Using the method of studying the structure of the problem based on the use of matrix and graph models at the phase of preliminary design, it was found that the power split in the bevel stage is possible at an angle between the axes of the bevel gear not equal to 90°. A comparative analysis of the found design with the existing gearbox at the phase of detailed design using the method of evaluating the variants for a design solution is made. Evidence of the effectiveness of heuristic methods is the development of a new gearbox design with better technical characteristics: smaller weight and dimensions. The developed heuristic methods are aimed at solving the tasks of designing transmissions; they can be used by designers, inventors and are interesting for experts in the field of heuristics.

Keywords: heuristic methods, transmission design, gearbox, graph model, matrix model.

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DEVELOPMENT OF SINGLE-PHASE HIGH-POWER FACTOR INVERTER WELDING SOURCES (p. 18–24)

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New topologies of single-phase inverter welding supplies with increased power factor are proposed. The need to increase the power factor of welding equipment is dictated by the introduction of modern standards of electromagnetic compatibility of technical equipment. One of the proposed power supplies is built on the basis of a modified forward-current converter, the other is based on a bridge converter. A distinctive feature of the presented power supplies with an increased power factor is the absence of additional inductive power components, a smaller capacity of the smoothing capacitor and a simplified scheme of limiting its charging current. The developed welding power supplies have an increased no-load voltage, which makes it possible to lightly ignite the arc during manual arc welding. Due to the increased power factor, the current consumed from the mains is 30 to 45 % lower than for widely used welding inverters without power factor correction. The presented circuit solutions of the converters allow creating welding inverter power supplies with a high-power factor, having a lower cost and better weight and size characteristics in comparison with professional welding inverters equipped with power factor correctors.

Keywords: power factor, welding inverter, welding source, ignition of arc, stabilization of arc burning.

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INVESTIGATION OF THE IMPACT OF THE GEOMETRIC DIMENSIONS OF THE IMPELLER ON THE TORQUE FLOW PUMP CHARACTERISTICS (p. 25–31)

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Torque flow pumps (TFP) exhibit low indicators of energy efficiency. This is related to the features in the operating process of their flowing part. Given this, improvement of elements of the flowing part of TFP looks promising in terms of increasing their energy efficiency. Taking into account the structure of the pump life cycle cost, the most rational is the improvement of the impeller

design without changing its overall dimensions. This will make it possible to increase the TFP efficiency with minimal investment cost.

The study was conducted using the method of experiment planning. This allowed us to rapidly and accurately determine the extent of impact of the selected factors on the pump operating parameters.

As a result of numerical investigation, we established the effect of the examined structural elements of the impeller on the pump parameters. A change in the design of the blade enabled a reduction of hydraulic losses in the inter-vane channels of the impeller. Alignment of the blade installation angle with the angle of a fluid inleakage decreased the resistance of input edge of the pump blade. As a result, hydraulic losses at the input of the impeller were reduced.

The study conducted allowed us to improve efficiency of the torque flow pump by 4–5 %. Adequacy of the results of numerical investigation was confirmed by performing a physical experiment.

Keywords: torque flow pump, Turo, impeller, numerical investigation, Ansys CFX, factorial experiment.

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EFFECT OF FLAME RETARDANT FILLERS ON THE RHEOLOGICAL PROPERTIES OF COMPOSITE MATERIALS OF ETHYLENE-VINYL ACETATE COPOLYMER (p. 32–37)

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We determined that viscous flow processes are influenced by composite materials of ethylene-vinyl acetate copolymer that do not sustain combustion and by flame retardant fillers. In the study, ethylene-vinyl acetate copolymer was used. The content of vinyl acetate is 18 % and 28 %; MFI is 2.5 g/10 min or 5 g/10 min. Flame retardant fillers include aluminum oxide trihydrates with an average diameter of particles of 1.5 μm and 3.0 μm; magnesium oxide dihydrates with an average diameter of particles of 3.0 μm and 3.7 μm and hydromagnesite with an average diameter of particles of 1.4 μm.

By using the method of capillary viscosimetry, we defined the following characteristics: melt flow index, shear stress, shear rate, effective viscosity and activation energy of viscous flow. Melt flow index decreases as the concentration of flame retardant fillers increases. The same tendency is observed when using flame retardant fillers with smaller average diameter of particles. Shear stress and effective viscosity, in contrast, increase.

We determined the influence of polymeric matrix, composition and dispersion of flame retardant fillers on the

rheological characteristics of polymeric compositions. The use of EVA with melt flow index of 5 g/10 min makes it possible to obtain the filled polymeric compositions with improved rheological properties.

The obtained results might be useful in the process of designing the formulations for polymeric compositions for cable products and for regulating technological indicators during their processing.

Keywords: composite materials, fire resistance, ethylene-vinyl acetate copolymer, flame-retardant fillers, rheological properties.

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ANALYSIS OF ACOUSTIC EMISSION AMPLITUDE PARAMETERS WHEN INCREASING THE MACHINING DEPTH OF A COMPOSITE (p. 38–43)

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Optimization and control of technological parameters in the machining of composite materials is an important task to ensure quality of the manufactured products. Studies are undertaken to solve the given problem using the method of acoustic emission. We considered procedure and results of experimental research into parameters of acoustic emission signals when changing the depth of composite machining. It was determined that increasing the depth of composite material machining did not not affect the character of acoustic radiation. Acoustic emission is continuous. However, there occurs an increase in the mean level of amplitude of the registered emission signal and the magnitude of its variability. We determined statistical amplitude parameters of acoustic emission signals at increasing the depth of composite machining. The data approximation was performed and the mathematical notation derived of the regularities at an increase in the mean level of amplitude, its standard deviation and variance with increasing machining depth. It was established that regularities of the increase in the amplitude parameters of acoustic emission signals were well described by nonlinear functions. It was determined that the most sensitive and informative parameter of the registered acoustic emission signals was a variance in the mean level of amplitudes.

It is shown that the percentage increase in the variance of the mean level of signal amplitude outpaces the percentage increase in the mean level of amplitude and its standard deviation. The obtained patterns could be used for the optimization of technological processes. When conducting machining – to monitor, control and manage the depth of machining a composite with the assigned structure.

Keywords: acoustic emission, composite material, signal amplitude, machining, statistical characteristics, cutting depth.

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STUDY OF THE PROCESS OF SHAPE-FORMATION OF RIBBED DOUBLE-CURVATURE PANELS BY LOCAL DEFORMING (p. 43–49)

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Accuracy of double-curvature ribbed panels obtained by multipoint local deformation using the proposed procedure of distribution of local actions was studied. As equipment for local action, an innovative die was used enabling the rib portion to be bent together with the adjacent sheet in both directions and perform shrinking (shortening) or stretching (extension) of this section along the rib axis. Features of making double-curvature panels with an irregular internal structure using local shaping by bending and shrinking (stretching) were considered. A procedure was described for calculating the number of local actions necessary to obtain panels of the required shape and size. The results obtained in testing the procedure for distributing local actions on samples and the full-scale panel of an aircraft fuselage of a transport category were presented. An experimental study of accuracy of the obtained dimensions by comparison of measurements of height of the points in the shaped panel with calculated values of the panel coordinates was carried out. Experimental studies of accuracy of the panel face shape showed that the maximum deviation after applying the calculated actions was 1.48 mm for longitudinal sections and 1.67 mm for transverse ones. Individual deviations of the shape, for example deviations of the free edges and curvature near the ends of the ribs required refinement works after which the shape deviations did not exceed 0.3 mm. Basic recommendations were elaborated for making double-curvature (biconvex, biconcave, convexo-concave and concavo-convex) panels.

Keywords: double curvature, irregular internal structure, shrinking, plastic deformation, flexure.

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EXAMINING A CHANGE IN THE PROPERTIES OF COARSE WOOL FIBER UNDER THE INFLUENCE OF ELECTRICAL DISCHARGE TREATMENT (p. 50–55)

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Modification of coarse wool fibre is a basic condition for improving quality of the manufactured woolen textile products while reducing their cost. Traditional methods of modification of wool are expensive, that is why the implementation of these methods into existing technological modes is not always economically justified. The obtained effect of modification is often associated with undesirable damage of protein structure of fiber. A solution to this problem is the application of electric discharge treatment, accompanied by the emergence of electric discharge non-linear bulk cavitation. It is shown that the influence of electrohydrolic shock and products of water cleavage on wool does not cause profound destruction of keratin, in contrast to enzymatic and plasmochemical methods of treatment.

Based on the performed experimental studies, it was determined that during electric discharge treatment of coarse wool there occurs the compaction of fiber cuticles and a change in supramolecular structure of keratin. This fact predetermines a decrease in felting ability of wool fibre, an increase in sorption properties, as well as in resistance to hydrolysis and influence of oxidants and reductants.

It was established that the application of electric discharge treatment as a method of coarse wool modification would contribute to a decrease in shrinking and improvement of optimized dyeing of woolen textile material.

Thus, the proposed technology of wool improvement will make it possible to use less expensive raw materials for the production of textile materials for different purposes.

Keywords: coarse wool, modification of wool, electric discharge cavitation, surface morphology, porous structure, chemical structure of keratin.

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RESEARCH INTO THE PROCESS OF MECHANICAL FORMATION OF THE UPPER PART OF A RAW COTTON BUNDLE (p. 56–63)

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The process of formation of the upper part of a raw cotton bundle was examined. We proposed a method for kinematic analysis of mechanisms of the cotton-processing machines, including a mechanical bundling press, and developed an algorithm for its computer implementation. The proposed method makes it possible to obtain equations for determining the kinematic parameters of a mechanism for the formation of the upper part of a cotton bundle at the assigned law of the motion of a drive link, which is the cam. We experimentally studied the possibility of forming the upper part of a bundle with the required density of cotton, which ensures stability of the formed bundle. Taking into account the influence of density of raw cotton in the bundle on the adhesion between waste and cotton, and based on the impact of this on the cleaning effect, we conducted theoretical and experimental research. The study performed allowed us to determine the density of raw cotton in a bundle depending on the time and height of the bundle, and to investigate the influence of waste adhesion on the ginning effect.

Keywords: raw cotton, cotton bundle, bundle shape, upper part of a bundle, cam, bundle density, grate, ginning effect, adhesion.

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